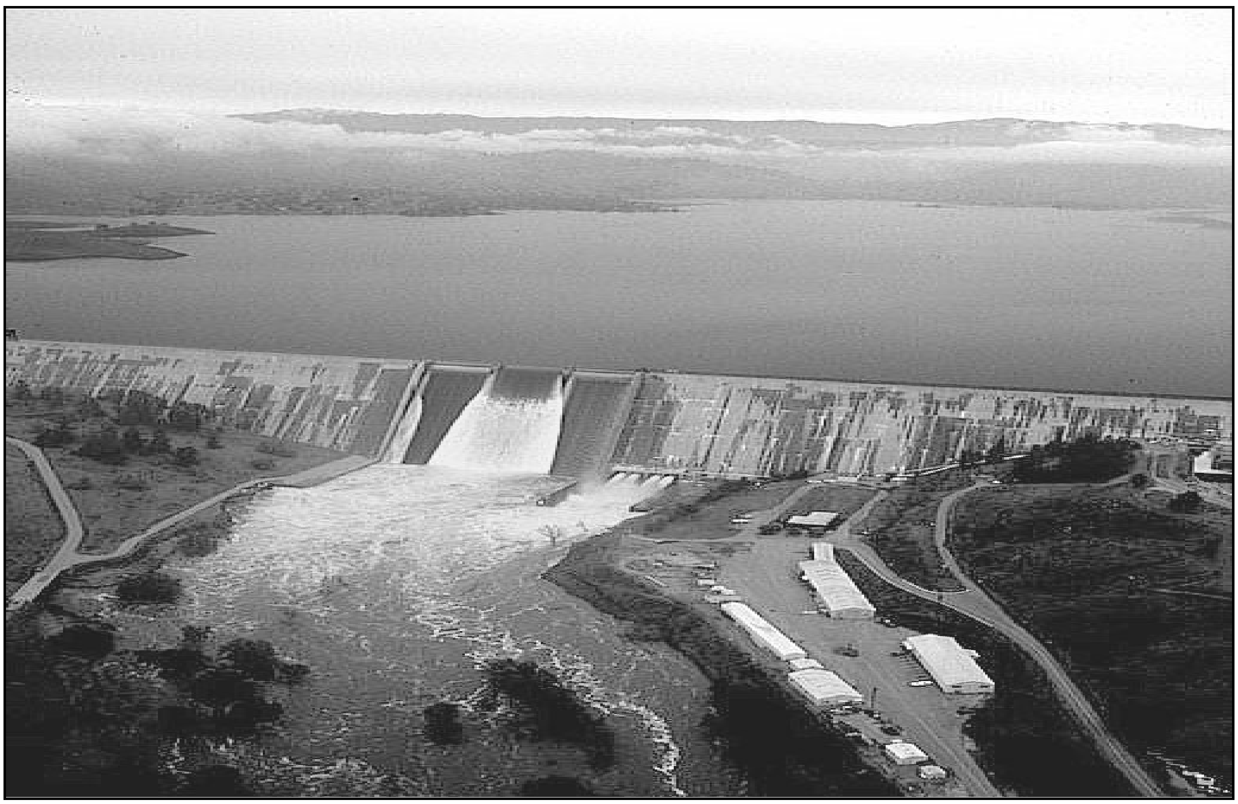
CHAPTER 6

ASSESSMENT OF CURRENT FLOOD MANAGEMENT SYSTEMS



US Army Corps of Engineers
Sacramento District

Post-Flood Assessment for 1983, 1986, 1995, and 1997
Central Valley, California

CHAPTER 6

ASSESSMENT OF CURRENT FLOOD MANAGEMENT SYSTEM

As discussed in previous chapters, the flood management systems in the Sacramento and San Joaquin River basins were developed incrementally over a period of many years in response to major floods. Initial efforts in both the Sacramento and San Joaquin River basins focused on improving conveyance of flood waters through the system and protecting lands adjacent to the rivers. This was accomplished through the construction of levees and then bypasses, and later through the development of the major multipurpose reservoirs which provided flood reservation storage (see Table 2-1 for details). Thus, the current flood management systems reflect the incremental development of flood protection projects. This method of development has resulted in systems that require extensive coordination among several agencies to operate and maintain.

Capacity problems occur in both systems for a variety of reasons, including reduced channel cross section, reduced levee strength, seepage, land use changes, and encroachment by development or vegetation in channels. This chapter describes current problems in the flood management systems, compares recently completed flow-frequency curves to previous estimates, identifies areas and population at risk, and describes the value of damageable property at risk, both structural and agricultural.

FLOOD-RELATED PROBLEMS

SACRAMENTO RIVER

Although the flood management system on the Sacramento River has prevented billions of dollars in damages over time and has contributed greatly to the economic development of the State and Nation, serious flood-related problems still exist. The various problems along the system have been examined and are discussed in the general problem statements that follow.

The Sacramento River Flood Management System was designed in response to two major floods early in the century, but more recent floods have shown that greater flows and volumes should be expected.

Since its basic structure was incorporated in the early 1900's, the flood management system in the Sacramento River Basin has allowed for great economic development and has prevented billions of dollars in flood damages. At the time of its original construction, the flood management system was thought to be capable of controlling most, if not all, conceivable floods. Since that time, however, several flood events have resulted from storms producing greater runoff amounts than anticipated in earlier times. In addition, several important changes have resulted in a system, however modified from the original, that provides a level of flood protection less than that for which it was designed. The level of protection provided is less than what may be considered adequate.

Some changes are a result of changes in the uses of the water and related land resources in the basin. Other considerations reflect a higher level of knowledge of the uncertainty, or variability, inherent in the conditions of the basin. Flood management agencies and others recognize that providing total protection from flooding is not feasible because of these changes. Decisions must be made about what levels of flood risk are acceptable for the different existing and potential future floodplain land uses in the basin.

The Sacramento River Flood Management System may not have the capacity to convey peak design floodflows. Additional studies are needed to determine the location and extent of the capacity deficiencies.

The design of the original Sacramento River flood management system, authorized for construction in 1917, was based on two floods in the preceding decade. Those floods were considered at that time to be the largest floods that could reasonably be expected. Conditions have changed since then, however, and the capacity of the system to handle floods that can now be expected is less than originally planned. In addition, more than 80 years of additional knowledge of the system provides a better planning base.

- Some sections of levee in Yolo County have subsided. For example, subsidence due to overdrafting of the underlying aquifers through pumping of groundwater has reduced the levee height. This has resulted in a reduction of the channel capacity in these areas and increased the potential for levee overtopping during high flows.

- Sediment transport, erosion, and deposition have changed since the current system was originally designed. The leveed river sections were designed not only to maintain high enough stages for ship navigation but to keep flow velocities high enough to transport hydraulic mining debris through the system. The debris is all but gone, but the river still has the same sediment transport capacity, which contributes to the degradation of the Sacramento River channel and the erosion of the levee system.

- The timing of coincident flows throughout the system for recent past floods has been different from the events for which the system was designed. The original system was designed based on the 1907 and 1909 floods. In 1998, an additional 81 years of flood record are available with a range of hydrologic conditions that need to be considered. A review of the flood record (see Chapter 5 for details) suggests that the characteristics of the major floods throughout this time have varied significantly in location, duration, magnitude, frequency, and timing. Thus, the flood characteristics have been unique for many of the floods or series of floods, and are often quite different from those originally planned.

- Under some flood scenarios, the Tisdale Weir and Bypass may not provide design capacity. At times high stages in the Sutter Bypass appear to prevent Sacramento River overflows from escaping the leveed river over the Tisdale Weir. This means that more than the design flow is conveyed down the river; therefore, the level of protection provided downstream, particularly between the Tisdale Weir and Knights Landing may be affected.

Parts of the Sacramento River Flood Management System do not provide reliable flood protection because of structural integrity problems.

Levee instability and seepage problems, for example, may be due to inadequate levee and foundation materials, as well as the construction of drainage ditches on the landside of the levees. Many levees were constructed by private interests without using engineering designs and standards.

Maintaining the Sacramento River Flood Management System is extremely costly due to the erosive nature of the floodflows in the current system configuration.

The flood management system in the Sacramento River Basin was originally designed to address primarily the effects of flooding on agriculture and to provide for continued river navigation. To flush the huge amounts of hydraulic mining debris through the system, thereby keeping it off the farmlands and providing adequate draft for ships, the main stem of the river was confined to a narrow corridor between levees. Over the first half of this century, the need for navigation declined significantly, and the system effectively flushed through most of the mining debris.

The mining debris is now all but gone, but the river still has the same transport capacity, which contributes to erosion of the levee system. It was at this time–about the middle of this century–that the decision was made to provide erosion control in the form of the Sacramento River Bank Protection Project. This action has resulted in a continual process of attempting to counteract the natural forces of the river. Just as we have learned that total control of floods is not possible, experience in managing the system has also taught us that total control of geomorphology is not feasible and that managing its effects is a more reasonable approach. In addition, over the first half of the century the natural floodplain was converted primarily to agricultural land, with urban development in concentrated areas within the basin. The same agricultural activity that has grown and benefitted from the confinement of the river is now at the greatest risk of being flooded and lost to erosion. At the same time, increasing urban development has increased the damage potential from flooding.

The need for protecting the tightly leveed system from erosion continues. As protection is implemented (as rock riprap typically), riparian habitat is affected. Degradation of the Sacramento River channel due to erosion and scour may be causing revetment toe failures along miles of the river. Mitigation costs have increased exponentially over time.

The level of flood protection provided by the Sacramento River Flood Management System is not adequate for the protected land use for many parts of the system.

The flood management system was designed with varying levels of protection, based on the value of property and production at risk of flooding. It is likely, however, that the level of protection throughout the system is no longer correlated to the value of property and production at risk of flooding. An adequate model has not been developed to evaluate the overall hydraulic performance of the system.

It is difficult to evaluate operational changes that would optimize flood protection because no models are available that can adequately simulate the system.

Flood management on the Sacramento River is a complex task due in part to the many flood management facilities, the large uncontrolled drainage areas, and long travel times. A long standing need exists for hydrologic, hydraulic, and ecosystem functions models that cover the entire system and would allow simulation of different operating strategies. The existing pieces of models need to be combined and gaps filled.

The level of flood protection on the American River in the Sacramento Metropolitan area is less than should be expected for a major urban area.

Previous and ongoing studies have highlighted the flood threat posed to the City of Sacramento and surrounding metropolitan area by the American River. These studies looked at possible methods for reducing the flood risk, including levee restoration and raising, channel modifications, and increased flood management storage in the upper American River.

Large unregulated watersheds in the Sacramento River Basin make flood management difficult. For example, the South Fork of the Yuba River is unregulated and yet it accounts for about 60 percent of the flows in the Yuba River at Marysville

Between Shasta Dam and the City of Sacramento, more than 50 percent of the drainage area tributary to the Sacramento River is unregulated for flood management. The large floodflows from these areas can exceed channel capacities and make flood management operations complex as operators attempt to account for unregulated flows in their release decisions.

SAN JOAQUIN RIVER

Although the flood management system on the San Joaquin River has prevented billions of dollars in damages over time and has contributed greatly to the economic development of the State and Nation, flood-related problems still exist. The various problems along the system have been examined and are discussed in the general problem statements that follow.

The San Joaquin River Flood levee and channel system lacks the capacity to convey design floodflows. Additional studies are needed to determine the location and magnitude of the capacity deficiencies.

The San Joaquin levee system was originally designed to convey both rainfall and snowmelt events. Reservoirs constructed on major tributaries were designed primarily to manage the substantial snowmelt that is common in the San Joaquin River Basin. Although the most frequent source of flooding in the San Joaquin River Basin is due to snowmelt, substantial flooding can also result from rain. In addition, the flow carrying capacity of the system has diminished steadily over time. The following factors have contributed to diminishing the flow capacity of the system.

- The sediment load in the San Joaquin system is significant. Channel sedimentation throughout the system has diminished the overall flow capacity.
- Localized channel "choke points," created by vegetation and/or sedimentation, can cause flow restrictions leading to higher stages upstream from the restriction.
- At the downstream limits of the existing project, the system appears to be undersized and does not extend far enough into the Delta to pass design flows adequately.
- In some reaches in the system, the levee alignments converge to create "pinch" points that restrict capacity and create higher stages at high flows.
- Several bridges in the system restrict flow and cause higher stages.
- Land subsidence in the basin south of the Merced River has reduced the carrying capacity of the system and has increased sedimentation in some reaches and erosion in others.
- Very low summer flows contribute to the growth of vegetation in the low-flow channels; the vegetation then increases channel deposition and decreases conveyance.
- Many of the levees lack the structural integrity needed to convey flows at design stage.

No one entity has responsibility to maintain the capacity of the river channel from the Merced River downstream to the Delta, leading to continually decreasing capacity.

Levee maintenance districts have been established to collectively maintain the many miles of levees in the San Joaquin system and The Reclamation Board has oversight over encroachments in the floodway through its encroachment permit program. However, no public or private entity has been given the responsibility of maintaining the flow-carrying capacity of the river channel from the Merced River downstream to the Delta.

Parts of the levee system do not provide reliable flood protection because of structural instability, poor foundation conditions, and excessive seepage.

Many levees in the San Joaquin River Basin were constructed close to the river channel using river bottom materials. As these levees become saturated, water seeps through the levees threatens their structural integrity. When seepage is a problem, river stages must be reduced to allow drainage and reduce the potential for failure. System operators must then reduce releases from the reservoir to levels below channel capacity, thereby reducing the level of protection against flooding by filling the flood management reservation.

On many levees, seepage problems are exacerbated by the presence of landside drainage ditches that collect drain water from agricultural fields. Drainage ditches near the landside levee toe can shorten seepage paths and often contribute to seepage and levee instability. During winter months, local precipitation fills the drainage ditches, so water is against the foundation of the levee on the landside. This water helps saturate the levee foundation and increases the frequency of seepage problems. The ditch may also intercept lenses of pervious materials thereby shortening the seepage path under the levee.

Current operation plans for the existing reservoirs and the lack of storage, both as reservoir storage and as storage within the natural floodplain, prevent the optimal use of the flood management system.

Flood releases from projects in the San Joaquin River system are generally managed to minimize peak flows on the tributary rivers where the project was authorized rather than to reduce peak flows along the main stem of the San Joaquin River. This problem is aggravated by the fact that the channel system was not designed to carry the combined peak flow resulting from sustained inflows from the various tributaries. Additionally, not all available facilities (i.e. Kern River Intertie) are available for interbasin or intrabasin flood management. The current regulations need modification.

Based on past performance and relative to the rest of system, there appear to be reservoir storage deficiencies in the upper watersheds of the San Joaquin and Tuolumne rivers.

Most of the multipurpose reservoirs in the system were designed to provide the maximum water supply possible through management of snowmelt runoff. During flood operations opportunities are limited to spread the degree of risk between potential loss of water supply and high flood releases. The water supply stakeholders are often not the same parties that would sustain damage due to higher reservoir releases. Consequently, there is a reluctance to allow encroachment into the conservation storage to provide increased flood protection.

It is difficult to evaluate operational changes that would optimize flood protection because there are no models available that can adequately simulate the system.

Flood management on the San Joaquin River is a complex task due in part to the many flood management facilities, the large uncontrolled drainage areas, and long travel times. A long standing need exists for hydrologic, hydraulic, and ecosystem functions models that cover the entire system and would allow simulation of different operating strategies. The existing pieces of models need to be combined and gaps filled.

REGULATED FLOOD FLOW-FREQUENCY ANALYSIS

REGULATED FLOOD FLOW-FREQUENCY CURVES

Regulated peak flood flow-frequency curves were developed at several selected locations within the Sacramento and San Joaquin River basins and the Tulare Lake Basin. The curves were developed to establish the relative frequency of annual peak flows at each location. Tables 6-1 to 6-3 include a list of the selected locations. Earlier curves developed at or near these locations were reevaluated and updated to incorporate recent floods including 1983, 1986, 1995, and 1997. The regulated peak flood flow-frequency curves at the identified locations are shown on Plates 1 to 33 in Appendix F. Appendix F also includes additional information on each location and on the methodology used in developing the curves.

Due to the minimal amount of historical data, the regulated curves were only developed up to the 1 percent chance exceedence (100-year) event unless hypothetical events were developed. Recent Corps flow-frequency analyses and reservoir modeling, funded by FEMA, produced hypothetical events up to the 0.1% chance exceedence (1,000-year) event for several tributaries. The regulated hypothetical events were developed using balanced inflow hydrographs based on unregulated flow-frequency curves fitted to a distribution and derived from long-term historical records. The unregulated frequency curves used to develop the hypothetical events were based on computed probability.

Tables 6-1, 6-2, and 6-3 also present the estimated exceedence interval (range in years) of each of the selected 1983, 1986, 1995, and 1997 floods at each location. For the locations downstream from where the Sacramento and San Joaquin rivers leave the foothills and flow into the broad floodplain, the exceedence intervals are based on the regulated peak flood flow-frequency estimates. These locations within the Sacramento River Basin are Vina Bridge, Butte City, Colusa, Wilkins Slough, and the latitudes of Verona and the City of Sacramento. The locations within the San Joaquin River Basin are El Nido, Newman, Maze Road Bridge, and Vernalis.

The exceedence intervals on the tributaries and the main stem gages at Keswick, Bend Bridge, Friant Dam and Gravelly Ford are based on unregulated flood frequency-volume-duration estimates for each flood. The flood frequency derived from unregulated volumes provides a more realistic estimate of the magnitude and expected exceedence of the flood at each location. Frequency estimates based on unregulated volumes can differ significantly from regulated estimates for several reasons.

- Low starting storage levels (significantly below the bottom of the flood pool) prior to a flood may result in much smaller releases below a major flood control reservoir than are expected for the magnitude of the event. Low starting storage levels in reservoirs upstream from major flood control reservoirs can also result in smaller flood releases.

- Typically, a flood control project's objective release can be expected to occur for a broad range of flood-frequencies. For example, the objective flow (5,000 cfs) for the Mokelumne River below Camanche Dam can be expected for flood exceedence intervals ranging from 8-50 years; see Plate 13 in Appendix F. Using the unregulated frequency estimate helps to better define the range for the specific event during which the maximum release of 5,000 cfs was obtained.

- A storm's centering can also have a major impact on frequency estimates. For example, a storm may be centered upstream from a major flood control reservoir project and not over the intervening local contributing drainage between the project and the selected downstream location. The 1997 flood was the flood of record above Shasta Dam, but it was not the flood of record for the local tributaries between Keswick Dam and Bend Bridge. Using unregulated flood frequencies at Shasta Dam and Bend Bridge results in more consistent frequency estimates at both locations for the specific flood.

- On the lower reaches of the main stem of the Sacramento River, flows spread out across low-lying basins, over weirs, and through wide bypasses. This distribution of flow affects the computation of reliable estimates of unregulated flows. Also, locations along lower reaches of main stem rivers represent large drainage areas, often tens of thousands of square miles, where a high percentage of the area is unregulated. The contributing drainage area is generally too large for most major storms to be centered over the entire basin. In effect, several historical observed high flows of similar magnitude can result from different storms centered throughout the basin. For these reasons, the regulated curves should provide reasonable frequency estimates.

TABLE 6-1
ESTIMATED EXCEEDENCE INTERVAL OF HISTORICAL FLOODS IN THE SACRAMENTO VALLEY

Location	Plate No.[2]	Historical Floods (Exceedence Interval, range in years)			
		Feb-Mar 83	Feb 86	Mar 95	Dec 96 -Jan 97
Sacramento River Basin					
Sacramento River at Keswick[1]	1	5-15	25-40	10-25	95-140
Sacramento River above Bend Bridge[1]	2	10-20	20-35	10-25	50-85
Sacramento River at Vina Bridge	3	50-80	5-10	5-10	5-20
Stony Creek below Black Butte Dam[1]	4	15-25	35-50	25-35	5-15
Sacramento River at Butte City	5	50-70	5-10	5-10	10-20
Sacramento River at Colusa	6	30-80	20-50	5-20	5-20
Sacramento River below Wilkins Slough	7	20-50	50-80	10-20	15-30
Feather River Basin					
Feather River at Oroville[1]	8	5-10	40-55	10-15	95-135
Feather River at Shanghai Bend[1]	9	5-10	40-55	10-15	85-130
Sacramento River at the Latitude of Verona	10	5-10	30-50	5-10	90-110
Sacramento R. at the Latitude of Sacramento	12	5-10	50-80	5-10	90-110
American River Basin					
American River at Fair Oaks[1]	11	3-5	55-65	5-10	50-60

Notes:

1 Exceedence Interval of flood estimated from unregulated volume-duration flood flow-frequency relationships

2 Plates are included in Appendix F

TABLE 6-2
ESTIMATED EXCEEDENCE INTERVAL OF HISTORICAL FLOODS IN THE SAN JOAQUIN RIVER BASIN

Location	Plate No.[2]	Historical Floods (Exceedence Interval, range in years)			
		Feb-Mar 83	Feb 86	Mar 95	Dec 96 -Jan 97
San Joaquin River Basin					
San Joaquin River below Friant Dam and at Gravelly Ford[1]	18-19	10-20	25-50	10-25	60-80
Fresno River below Hidden Dam[1]	20	10-20	15-30	15-30	25-45
Chowchilla River below Buchanan Dam[1] Ash Slough below Chowchilla River[1] Berenda Slough below Chowchilla River[1]	21-23	10-20	15-30	10-20	15-25
Eastside Bypass near El Nido	24	10-20	5-10	5-10	80-100
Merced River at New Exchequer Dam and at Cressy[1]	25-26	10-20	20-40	10-20	50-60
San Joaquin River at Newman	27	25-50	10-20	5-10	90-110
Tuolumne River at Don Pedro Dam and at Modesto[1]	28-29	15-25	30-40	5-15	80-110
San Joaquin River at Maze Road Bridge	30	15-25	10-20	5-10	80-110
Stanislaus River at New Melones Dam and at Orange Blossom Bridge[1]	31-32	5-10	30-50	10-15	50-70
San Joaquin River at Vernalis	33	30-50	15-25	5-10	80-110
Eastside Tributaries					
Mokelumne River below Camanche Dam[1]	13	3-6	30-40	3-10	55-65
Calaveras River below New Hogan Dam and Mormon Slough at Bellota[1]	14-15	5-10	55-75	3-7	5-15
Littlejohn Creek below Farmington Dam and at Farmington[1]	16-17	10-15	30-45	3-6	5-10

Notes:

1 Exceedence Interval of flood estimated from unregulated volume-duration flood flow-frequency relationships

2 Plates are included in Appendix F

TABLE 6-3
ESTIMATED EXCEEDENCE INTERVAL OF HISTORICAL FLOODS IN THE TULARE LAKE BASIN

Location	Historical Floods (Exceedence Interval, range in years)			
	Feb-Mar 83	Feb 86	Mar 95	Dec 96 -Jan 97
Kings River at Pine Flat Dam[1]	5-10	20-40	10-20	40-60
Kaweah River at Terminus Dam[1]	5-10	10-20	5-10	15-25
Tule River at Success Dam[1]	5-10	10-20	5-10	10-20
Kern River at Isabella Dam[1]	5-10	10-20	5-15	15-25

Notes:

1 Exceedence Interval of flood estimated from unregulated volume-duration flood flow-frequency relationships

All regulated peak flood flow-frequency curves (Plates 1 to 33 in Appendix F) reflect existing conditions except at identified locations affected by levee failures. At those locations, the impacts of the levee failures were removed. The curves were extended to the 100-year exceedence interval by routing hypothetical events. Historical peak flows were plotted using median plotting positions. An explanation of several selected curves, by location, is included in the following sections.

Sacramento River Basin

Sacramento River at Keswick. The historical peak flow record (1944-98) is the period after completion of Shasta and Keswick dams. The more frequent releases from 12,000 to 16,000 cfs reflect normal conservation or power releases, whereas the objective flood control release from Keswick Dam is 79,000 cfs.

Sacramento River Above Bend Bridge. The flows at Bend Bridge are regulated by Shasta, Keswick, and Whiskeytown dams. The maximum historical flows are predominantly a result of the uncontrolled local drainage (2,432 square miles). The major contributing tributaries are Cottonwood, Cow, and Battle creeks. During peak flow periods, releases from Keswick Dam are generally at or below 20,000 cfs. The objective flow at Bend Bridge is 100,000 cfs.

Sacramento River at Vina Bridge. The flows at Vina Bridge are regulated by Shasta, Keswick, and Whiskeytown dams. The maximum historical flows are predominantly a result of the uncontrolled local drainage (4,510 square miles). The major contributing tributaries between

Bend Bridge and Vina Bridge are Mill, Deer, and Thomes creeks. During peak flow periods, releases from Keswick Dam are generally at or below 20,000 cfs. The channel capacity at Vina Bridge is 84,000 cfs. The maximum recorded discharges for the main river do not include water bypassing the station on the left bank. The exceedence intervals listed in Table 6-1 are based on the regulated flood flow-frequency (Plate 3 in Appendix F). Estimates of exceedence intervals for unregulated conditions at Vina Bridge and downstream would be similar to those tabulated for the Sacramento River at Keswick and above Bend Bridge. Likewise, exceedence intervals based on regulated flood flow-frequency for the Sacramento River above Bend Bridge would be similar to the estimates tabulated for the Sacramento River at Vina Bridge. Vina Bridge is near where the Sacramento River leaves the foothills and flows into a broad floodplain.

Stony Creek Below Black Butte Dam. The historical record (1965-98) is the period after completion of Black Butte Dam. The objective flood control release from the dam is 15,000 cfs.

Sacramento River at Butte City. Flows in the Sacramento River at Butte City are confined by project levees on both sides of the river. The right (west) bank levee begins just below Ord Ferry and continues downstream to the Sacramento Delta. Fremont Weir, below Knights Landing, is the first flood control structure on the right bank to permit floodflows to leave the river. The left bank levees begin just upstream from Butte City. During floods, overbank flow into Butte Basin occurs upstream from the left (east) bank levee when flows exceed 90,000 cfs. The combined overbank flow and eastside tributary runoff then flows south on the east bank floodplain into Butte Basin and the Sutter Bypass before reentering the Sacramento and Feather rivers above Verona and the Fremont Weir. The Sacramento River's design channel capacity at Butte City is 160,000 cfs.

Sacramento River at Colusa. Flows are confined by project levees on both sides of the river. There are two relief structures upstream on the left bank between Butte City and Colusa. When discharge exceeds about 60,000 cfs, flow begins to spill over Moulton Weir, 25.1 miles upstream, into the Butte Basin. When discharge exceeds about 30,000 cfs, flow begins to spill over Colusa Weir, 2.5 miles upstream on the left bank, into the Butte Basin and the Sutter Bypass. Flows at Colusa do not include flows over Colusa and Moulton Weirs. The Sacramento River's design channel capacity at Colusa is 65,000 cfs.

Sacramento River Below Wilkins Slough. Flows are confined by project levees on both sides of the river. Above 23,000 cfs, flows begin to spill into the Sutter Bypass over the Tisdale Weir, 1 mile upstream on the left bank. Flows at Colusa do not include flows over the Tisdale Weir. The Sacramento River's design channel capacity at this location is 30,000 cfs.

Feather River at Oroville. Flows in the Feather River at Oroville are regulated by Oroville Dam; therefore, the historical record (1969-97) is the period after completion of the Oroville Project. The more frequent flows from 3,000 to 17,000 cfs are a result of normal conservation or power releases. The objective flood control release from Oroville Dam is 150,000 cfs.

Feather River at Shanghai Bend, Below Yuba River. The regulated curve reflects operation of Oroville and New Bullards Bar dams. The objective flow at Shanghai Bend is

300,000 cfs. During peak flow periods of major floods, a large percentage of the flows are generated by 1,200 square miles of predominantly uncontrolled drainage upstream from Shanghai Bend and downstream from Oroville and New Bullards Bar dams.

Sacramento River at the Latitude of Verona. The maximum 1-day flows reflect the sum of flows in the Sacramento River, Feather River, and the Sutter Bypass at their confluence above Verona and the Fremont Weir. Winter floodflows from the Colusa Basin, prevented from entering the Sacramento River at Knights Landing, pass through the Knights Landing Ridge Cut and enter the Yolo Bypass below the Fremont Weir. Colusa Basin flows are included in the frequency curve flows for the latitude of Sacramento. The regulated curve at the latitude of Verona reflects actual and simulated upstream regulation minus the effects of historical levee breaks.

American River at Fair Oaks. The flows in the American River at Fair Oaks are entirely regulated by Folsom and Nimbus dams (period of record: 1955-98). The objective flow at Fair Oaks is 115,000 cfs. The more frequent flows from 2,500 to 5,000 cfs reflect normal conservation or power releases. The maximum power release at Folsom Dam is about 8,000 cfs. Folsom Dam operation during hypothetical events is in compliance with the water control diagram agreed upon by the Bureau of Reclamation and SAFCA (initiated in 1994). The peak historical flow of 130,000 cfs occurred during the February 1986 flood.

Sacramento River at the Latitude of Sacramento. The maximum 1-day flows reflect the sum of flows of the Sacramento River at Sacramento, the Yolo Bypass at Woodland, and the American River. The Yolo Bypass at Woodland includes flow spills from the Fremont Weir and flows from the Colusa Basin and Cache Creek. The regulated curve at the latitude of Sacramento reflects actual and simulated upstream regulation minus the effects of historical levee breaks.

Eastside Tributaries to the Delta

Mokelumne River Below Camanche Dam. The historical record (1965-97) is the period after completion of the Camanche Project. The objective flood release is 5,000 cfs. The more frequent flows from 1,500 to 2,000 cfs reflect normal conservation or power releases.

Calaveras River Below New Hogan Dam. The objective flood release from New Hogan Dam is 12,500 cfs. Since completion of New Hogan Dam, this release has not yet been achieved during the period of record (1962-98) .

Mormon Slough at Bellota. The flow at Bellota is regulated by New Hogan Dam. The maximum historical flows are predominantly a result of the uncontrolled local drainage (110 square miles). The objective flow in Mormon Slough at Bellota is 12,500 cfs.

As shown on Plate 15 (Appendix F), the peak flow at Bellota exceeded 15,000 cfs during the February 1986 flood because a portion of the release from New Hogan Dam contributed to the peak flow at Bellota before releases could be reduced to minimum flow. Releases ranged from 6,000 cfs several hours before the peak at Bellota to 2,000 cfs during the peak. The travel time from the dam to Bellota is more than 3 hours. However, the flow above 12,500 cfs was only a very short duration; therefore, no failures of the Mormon Slough Project were experienced. The following improvements made since 1986 should benefit flood control operation of New Hogan Dam and reduce the chance of exceeding 12,500 cfs in the future:

- Development of a real-time model of the river above Bellota

- Installation of a telemetered gage on Cosgrove Creek, a tributary just downstream from New Hogan Dam. The real-time flows at this location will provide a good indication of timing and magnitude of downstream local flows

Littlejohn Creek Below Farmington Dam and at Farmington. The flows at Farmington are regulated almost entirely by the Farmington Project. The project includes Farmington Dam, completed in 1951, and the Duck Creek Diversion Structure. The diversion structure diverts flow from Duck Creek into Littlejohn Creek, upstream from Farmington. The objective flow is 2,000 cfs both below Farmington Dam and at Farmington.

The frequency curve indicates several times when releases from Farmington Dam exceeded 2,000 cfs; however, peak regulated releases from the dam are not measured but are determined by gate ratings. The gate ratings, developed prior to dam construction, are theoretical. The releases made based on gate ratings may not reflect the actual release. Therefore, an indicated release greater than 2,000 cfs, based on the theoretical gate ratings, may have been made to maintain gaged flows near the objective flow of 2,000 cfs at Farmington, during periods when no contributing flows occurred from both the Duck Creek Diversion channel and the small intervening local drainage area below the dam.

San Joaquin River Basin

San Joaquin River at Friant Dam and at Gravelly Ford. The historical record (1949-97) includes the period after completion of Friant Dam. The objective flood control release from Friant Dam is 8,000 cfs. Flow in Cottonwood Creek and Little Dry Creek (including Big Dry Creek Reservoir releases) enters the San Joaquin River below Friant Dam and must be accounted for in the operation of Friant Dam. Under flood conditions, floodflows can also be diverted into the Friant-Kern and Madera canals when capacity is available and there is a place to release the floodflows. Floodflows in the Friant-Kern Canal may be carried to the Kern River and then through the Kern River Intertie to the California Aqueduct. Floodflows in the Madera Canal may be carried to the Fresno-Chowchilla River system.

The plotted hypothetical events were given more weight when fitting the graphical regulated flow-frequency curve to the more rare events. This is because the regulated hypothetical events are developed using balanced inflow hydrographs based on frequency curves fitted to a distribution and derived from long-term historical records. Accordingly, the plotted regulated hypothetical events are considered more statistically reliable than the plotted regulated historical events.

Fresno River Below Hidden Dam. The historical record (1976-98) is the period after completion of Hidden Dam. The objective flood control release from Hidden Dam is 5,000 cfs.

Chowchilla River Below Buchanan Dam, Ash Slough Below Chowchilla River, Berenda Slough Below Chowchilla River. The historical record (1976-98) is the period after completion of Buchanan Dam. The objective flood control release from Buchanan Dam is 7,000 cfs (5,000 cfs in Ash Slough and 2,000 cfs in Berenda Slough).

Eastside Bypass Near El Nido. Flows at this site are regulated by Buchanan, Hidden, Friant, and Pine Flat dams. The channel design flow is 16,500 cfs; however, flows of 21,000 cfs have been recorded without levee failures or overtopping. The maximum 1-day flow-frequency curve of simulated and recorded flows reflects in-channel flows only. The frequency curve does not reflect additional minor flows in the San Joaquin River.

Merced River at New Exchequer Dam and at Cressy. The historical record (1968-97) is the period after completion of New Exchequer Dam. The objective flood control release from New Exchequer Dam is 6,000 cfs. Flows in Dry Creek enter the Merced River above Cress and must be accounted for in the operation of New Exchequer Dam.

San Joaquin River at Newman. Flows at this site are regulated by additional reservoirs on the Merced River, Los Banos Creek, and Merced Streams. The channel design flow at this location is 45,000 cfs; however, levees begin to fail or are overtopped when flows exceed 40,000 cfs near Newman. The maximum 1-day flow-frequency curve of simulated and recorded flows reflects in-channel and out-of-bank flows along the latitude of the channel.

Tuolumne River at Don Pedro Dam and at Modesto. The historical record (1971-97) is the period after completion of the new Don Pedro Dam. The objective flood control release from Don Pedro Dam is 9,000 cfs. Flows in Dry Creek enter the Tuolumne River at Modesto and must be accounted for in the operation of Don Pedro Dam.

The plotted hypothetical events were given more weight when fitting the graphical regulated flow-frequency curve to the more rare events. This is because the regulated hypothetical events are developed using balanced inflow hydrographs based on frequency curves fitted to a distribution and derived from long-term historical records. Accordingly, the plotted regulated hypothetical events are considered more statistically reliable than the plotted regulated historical events.

San Joaquin River at Maze Road Bridge. Flows at this site are regulated by additional reservoirs on the Tuolumne River. The channel design flow at this location is 46,000 cfs; however, levees begin to fail or are overtopped when flows exceed 40,000 cfs from Newman to Maze Road Bridge, except for one stretch. The San Joaquin River has limited channel capacity near the town of Grayson just upstream from the Tuolumne River. For periods of high flow at that location, Laird Slough carries most of the San Joaquin flow. The combined carrying capacity of San Joaquin River and Laird Slough is 26,000 cfs. The maximum 1-day flow-frequency curve of simulated and recorded flows reflects in-channel flows and out-of-bank flow along the latitude of the channel. Out-of-channel flows may have occurred in 1938 (41,600 cfs) and did occur in 1969 (41,800 cfs), 1983 (38,400 cfs), and 1997 (59,300 cfs).

Stanislaus River at New Melones Dam and at Orange Blossom Bridge. The historical record (1978-97) is the period after completion of New Melones Dam and includes regulation by Tulloch Dam. Tulloch Dam impounds part of the runoff from the foothill drainage area below New Melones Dam. The objective flood control release from New Melones and Tulloch is 8,000 cfs.

San Joaquin River at Vernalis. Flows at this site are regulated by additional reservoirs on the Stanislaus River. The channel design flow at this location is 52,000 cfs; however, levees begin to fail or are overtopped when flows exceed 40,000 cfs near Vernalis. The maximum 1-day flow-frequency curve of simulated and recorded flows reflects in-channel and out-of-bank flow along the latitude of the channel. Out-of-channel flows occurred in 1938 (45,600 cfs), 1969 (34,800 cfs), 1983 (44,700 cfs), and 1997 (48,800 cfs).

Tulare Lake Basin

Table 6-3 includes estimated exceedence intervals of historical flood events in the Tulare Lake Basin; however, revised frequency curves were not developed at these projects.

AREAS AND PROPERTY AT RISK

One way to define flood risk for an area is to develop different risk floodplains for that area. However, development of the tools necessary to adequately update and define the flood risk for the different economic assessment areas will not be available until they are developed in Phase II of the Comprehensive Study. Available information includes approximate 100-year floodplains that were developed by others for use in FEMA's National Flood Insurance Program (NFIP). These floodplains for the most part were developed using approximate methods and were done to quickly bring areas into the NFIP. A more detailed analysis of these initial FEMA floodplains may result in a redefinition of their initial flood risk.

Floodplains of this type are developed from two major analyses: discharge-frequency analysis to predict the 100-year discharge and hydraulic analysis to determine the water-surface elevation of this discharge along the stream course. The previous section presented updated frequency-discharge information in the two basins. These revised discharge-frequency curves were developed for different locations in the basins and are based on a data set that incorporates the most recent floods.

COMPARISON OF FLOW-FREQUENCY ANALYSIS

As a preliminary check to identify areas at risk, the 100-year discharges listed in the FEMA reports were compared with 100-year discharges from the revised curves. This allowed a comparison to determine where the FEMA 100-year floodplains would be considered still accurate in defining flood risk based solely on the forecasted discharges used at the time of development of the FEMA floodplains. The comparison is complicated by the differences in computing techniques and location of index points. Therefore, this comparison should be considered only a cursory evaluation to determine if significant differences are apparent. Future analyses in the Comprehensive Study will use these revised frequencies as well as newly developed hydrologic and hydraulic models and topographic information to better define the current flood risk. Table 6-4 shows the comparison between the discharges.

ECONOMIC ASSESSMENT AREAS

For organizational purposes, the two basins were separated into 93 economic assessment areas, as shown on the index Figure 6-1 and on the detailed views in Figures 6-2a through 6-2j. The areas were selected based on their risk from flooding and were defined based on several factors. The base determination was FEMA's 100-year flood mapping. Minor creeks and small tributaries that did not contribute significantly to the flows on the Sacramento or San Joaquin rivers were not included. Areas were added or extended to include communities outside the 100-year areas that are at significant risk of flooding from a potential levee failure. Figures 6-3a through 6-3j shows the land use within the economic assessment areas, based on the most recently completed land use analysis by DWR.

Value of Damageable Property at Risk

The number, category and value of damageable structures were determined by using parcel database information. Floodplain maps that delineated two hazard zones were used for the 93 economic assessment areas; first those within the FEMA 100-year floodplain and second those outside the 100-year flood, but within the potential damage area boundary. A fixed frequency of flooding, such as the 100-year flood, was not assigned to the potential damage area boundary. The areas within the potential damage area boundary were defined as those areas protected from flooding by levees. The boundary is the estimated extent of flooding that would occur from a levee break. Many of these areas are completely surrounded by levees, and in these cases the entire area was defined as being at risk. Next, the floodplain maps were overlaid on parcel book and page maps and the area common to both was used to select parcel data from the database.

Categories of Structures. Parcel data were separated into four categories, as summarized in Table 6-5. The total value of damageable property does not include structures that did not have values listed in the parcel database. Public buildings and infrastructure such as roads and bridges were not included. For the urban areas, such as Sacramento, the reported total values would be proportionally lower than the rural reaches if these data were available.

Adjustment of Structure Values. Because of California's Proposition 13, the assessed improvement values of structures listed in the parcel database do not reflect depreciated replacement values. Proposition 13 allows for improvement values to increase at a maximum rate of 2 percent per year from the date that a property is sold.

To adjust depreciated replacement values, Marshall and Swift Valuation was compared with the Proposition 13 maximum increases. Factors were estimated for updating books or pages based on average recording date. These factors were used to bring improvements to depreciated replacement values. Based on other district studies, where samples were taken and structures were valuated using several different methods, these valuations seem reasonable. While the adjusted assessed values tend to be slightly lower than comparable Marshall and Swift Valuation and recent sales data comparisons, for each study they have (on average) been within ten percent of the other valuation methods.

Content Values. Content values at risk were estimated as a percentage of the improvement value for each land use. Percentages used in several district studies were compared and generalized percentages were selected. For the land code COMM, contents were valuated at 100 percent of the structure value. For the remaining three codes, FARM, SEMI-PUB, and RES, 50 percent was used.

Population Estimates per Damage Area. Population for each damage area was estimated as a function of the number of residences and the number of people per household. Population data were gathered from the U.S. Census by county and was estimated to represent two resident types, urban and rural. The urban population per household was adjusted to reflect both single- and multi-family units. The rural population per household figures was adjusted to represent the estimated number of farm structures with residences. These population numbers are estimates and only reflect the number of people living within the economic assessment area. The actual number of people present during a flood event would depend on the time of day, day of the week, season, and even advance warning time. Some areas, such as downtown Sacramento, would have a much greater number of people at risk if flooding occurred during the work week when not only residents but employees and customers would be present.

SUMMARY OF PROPERTY AND POPULATION AT RISK

Table 6-6 includes the number of structures, the value of structure combined with content, and estimated population within the two hazard zones for the 93 economic assessment areas. The figures do not indicate potential damages but show comparable values at risk from flooding in each area. The two hazard zones, based on the FEMA 100-year floodplain, are used to give an idea of how much property is at some level of risk. These hazard zones include property within the FEMA 100-year floodplain for the first hazard zone, with the addition of areas protected by levees for the second hazard zone. Even though the level of protection offered by system levees may, in some cases, be less than 100-year, many of those levees would probably not fail during a given 100-year flood. Therefore, it is highly unlikely that every structure identified would be flooded at a given time.

In total, when combining the Sacramento River and San Joaquin basins, nearly 190,000 structures are at risk of flooding. More than 500,000 people live within the potential damage area boundaries, with almost $35 billion in damageable property. Note that this total does not include public structures not listed on parcel data, roads, bridges, public infrastructure, or automobiles.

Based on Corps studies in other areas, the addition of public structures could increase the value of property at risk by 5 percent to 20 percent for the urban areas.

AGRICULTURAL AREAS AT RISK

Besides structures at risk, many of the 93 economic assessment areas are also subject to agricultural losses from flooding. Land use acreage was determined to identify the types of crops at risk. A GIS database provided by the California Department of Water Resources delineated the different land uses by county. The land use layer was combined with the 93 economic assessment areas to determine the crop acreage at risk for each area.

The range of crop values (Table 6-7) was estimated based production per acre and value per unit numbers from the annual crop reports for various counties with the study. These values (listed in estimated 1998 prices) do not indicate the damages that would occur if flooded but do show that the various land uses have different values. Other factors, such at time of year, duration of flooding, velocity, sediment and debris content, and depth, affect the percent of crop loss. In addition to direct crop losses, flooding (even shallow depth , short duration) can cause damages in the form of clean up costs. Based on past studies, clean up costs could add from $ 100 to $ 300 per average acre to the total agricultural damages.

Land Use Categories Selected

Within the database, land use codes include more than 75 different crops. Categories were selected to reduce this number. Individual categories were selected based on total number of acres within the damage areas and value of crops at risk. The remainder of the land uses were placed in general categories. The remaining nonagricultural acres were placed in either idle, native vegetation, or urban categories. The categories selected, and corresponding acreage for each category in each area at risk, are shown in Table 6-8. Note that these acreages represent the best estimate at the time. Crop patterns and crop rotations change over time and from year to year. But the aggregate crop distribution shows type of crops in each economic assessment area.

TABLE 6-4
COMPARISON BETWEEN FEMA AND REVISED FREQUENCY DISCHARGES

Location	FEMA 100-Year Discharge	1998 Revised 100-Year Discharge	Current Estimated Frequency of FEMA Floodplain
SACRAMENTO RIVER			
At latitude of Sacramento (RM 59.0)	NV	650,000	Still 100-Year
At latitude of Verona (RM 79.0)	NV	500,000	Still 100-Year
At Ord Ferry (RM 184.2)	300,000[1]	290,000	Still 100-Year
Upstream from Pine Creek (RM 196.5)	260,000[1]	NV	Still 100-Year
At Vina Bridge (RM 218.3)	NV	210,000	Still 100-Year
FEATHER RIVER			
Upstream from Yuba River	155,000[2]	150,000	Still 100-Year
SAN JOAQUIN RIVER			
At Vernalis Gage (RM 72.6)	79,000[3]	50,000[6]	Greater than 100-Year
At Tuolumne River (RM 83.7)	77,000[4]	60,000	Greater than 100-Year
At Merced River (RM 118.1)	45,000[4]	40,000[6]	Still 100-Year
At Gravelly Ford (RM 229.0)	19,800[5]	60,000	40 - 50 Year
STANISLAUS RIVER			
At Oakdale	8,000[4]	8,000	Still 100-Year
TUOLUMNE RIVER			
At Modesto	41,000[4]	70,000	60 - 80 Year

Notes:
NV = No Value
1 From FIS, Glenn County, Unincorporated Areas.
2 From FIS, Yuba County, Unincorporated Areas, 1981.
3 From FIS, San Joaquin County, Unincorporated Areas, Vol. 1 of 3, 1997.
4 From FIS, Stanislaus County, Unincorporated Areas, 1989.
5 From FIS, Fresno County, Unincorporated Areas, 1996.
6 Reduction in discharge in downstream direction reflects impacts of levee breaks for these higher flows.

TABLE 6-5
CATEGORIES OF STRUCTURES

CODE	DESCRIPTION
COMM	Commercial and industrial buildings such as office buildings, restaurants, retail stores, warehouses, machine shops, etc.
FARM	Farm outbuildings, farmsteads with residences, barns, some agricultural processing facilities.
SEMI-PUB	Buildings listed in the tax assessors rolls such as churches, private schools, private recreation, clubs. Does not include tax-exempt local, State and Federal Government buildings or public schools.
RES	All urban and some rural residences. Consists of single-family residences, duplex structures, mobile homes, apartment complexes, townhouses, and residence hotels.

TABLE 6-6
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 1	COMM	542	$258.8		790	$580.8	
	FARM	99	$25.5		240	$41.2	
	SEMI-	34	$22.4		59	$37.0	
	RES	3,958	$392.1		6,893	$702.1	
	TOTAL	**4,633**	**$698.8**	**11,080**	**7,982**	**$1,361.1**	**19,380**
SAC 2	COMM	19	$7.8		41	$13.1	
	FARM	434	$77.4		447	$83.0	
	SEMI-	14	$5.5		16	$5.9	
	RES	386	$31.7		663	$47.9	
	TOTAL	**853**	**$122.4**	**1,570**	**1,167**	**$149.9**	**2,330**
SAC 3	COMM	0	$0.0		6	$0.6	
	FARM	0	$0.0		77	$6.2	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		43	$1.7	
	TOTAL	**0**	**$0.0**	**0**	**126**	**$8.5**	**230**
SAC 4A	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		192	$20.1	
	SEMI-	0	$0.0		3	$2.6	
	RES	0	$0.0		34	$2.6	
	TOTAL	**0**	**$0.0**	**0**	**229**	**$25.3**	**360**
SAC 4B	COMM	3	$0.1		4	$0.4	
	FARM	71	$10.0		148	$15.4	
	SEMI-	1	$0.2		1	$0.2	
	RES	11	$0.5		28	$1.7	
	TOTAL	**86**	**$10.8**	**120**	**181**	**$17.7**	**270**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 4C	COMM	23	$2.4		23	$2.4	
	FARM	156	$15.7		156	$15.7	
	SEMI-	4	$0.1		4	$0.1	
	RES	100	$14.7		100	$14.7	
	TOTAL	**283**	**$32.9**	**480**	**283**	**$32.9**	**480**
SAC 5A	COMM	168	$25.9		168	$25.9	
	FARM	26	$2.0		26	$2.0	
	SEMI-	25	$7.5		25	$7.5	
	RES	899	$66.5		899	$66.5	
	TOTAL	**1,118**	**$101.9**	**2,570**	**1,118**	**$101.9**	**2,570**
SAC 5B	COMM	13	$1.7		13	$1.7	
	FARM	143	$14.1		143	$14.1	
	SEMI-	10	$0.6		10	$0.6	
	RES	89	$4.8		89	$4.8	
	TOTAL	**255**	**$21.2**	**440**	**255**	**$21.2**	**440**
SAC 5C	COMM	0	$0.0		0	$0.0	
	FARM	130	$9.5		139	$23.9	
	SEMI-	6	$0.1		9	$0.7	
	RES	107	$6.4		107	$6.4	
	TOTAL	**243**	**$16.0**	**470**	**255**	**$31.0**	**480**
SAC 5D	COMM	0	$0.0		1	$5.0	
	FARM	0	$0.0		16	$3.4	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		1	$0.1	
	TOTAL	**0**	**$0.0**	**0**	**18**	**$8.5**	**20**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 6	COMM	0	$0.0		3	$0.6	
	FARM	0	$0.0		145	$7.0	
	SEMI-	0	$0.0		8	$0.3	
	RES	0	$0.0		289	$26.6	
	TOTAL	**0**	**$0.0**	**0**	**445**	**$34.5**	**1,140**
SAC 7	COMM	0	$0.0		12	$24.8	
	FARM	0	$0.0		25	$3.4	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		19	$1.5	
	TOTAL	**0**	**$0.0**	**0**	**56**	**$29.7**	**100**
SAC 8A	COMM	0	$0.0		10	$131.6	
	FARM	0	$0.0		154	$13.0	
	SEMI-	0	$0.0		5	$0.6	
	RES	0	$0.0		148	$15.2	
	TOTAL	**0**	**$0.0**	**0**	**317**	**$160.4**	**690**
SAC 8B	COMM	0	$0.0		809	$548.9	
	FARM	0	$0.0		225	$18.7	
	SEMI-	0	$0.0		99	$75.5	
	RES	0	$0.0		10,068	$1,172.3	
	TOTAL	**0**	**$0.0**	**0**	**11,201**	**$1,815.4**	**33,320**
SAC 9	COMM	0	$0.0		27	$24.0	
	FARM	0	$0.0		90	$4.6	
	SEMI-	0	$0.0		5	$0.8	
	RES	0	$0.0		123	$10.8	
	TOTAL	**0**	**$0.0**	**0**	**245**	**$40.2**	**520**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 10A	COMM	0	$0.0		387	$92.4	
	FARM	0	$0.0		0	$0.0	
	SEMI-	0	$0.0		34	$23.5	
	RES	0	$0.0		3,248	$276.9	
	TOTAL	**0**	**$0.0**	**0**	**3,669**	**$392.8**	**10,490**
SAC 10B	COMM	0	$0.0		27	$31.7	
	FARM	0	$0.0		95	$8.6	
	SEMI-	0	$0.0		8	$5.1	
	RES	0	$0.0		292	$41.2	
	TOTAL	**0**	**$0.0**	**0**	**422**	**$86.6**	**1,070**
SAC 11A	COMM	0	$0.0		186	$68.5	
	FARM	0	$0.0		35	$1.7	
	SEMI-	0	$0.0		39	$12.7	
	RES	0	$0.0		3,967	$271.2	
	TOTAL	**0**	**$0.0**	**0**	**4,227**	**$354.1**	**12,860**
SAC 11B	COMM	0	$0.0		6	$2.9	
	FARM	0	$0.0		65	$11.5	
	SEMI-	0	$0.0		2	$0.1	
	RES	0	$0.0		604	$36.0	
	TOTAL	**0**	**$0.0**	**0**	**677**	**$50.5**	**2,040**
SAC 12	COMM	0	$0.0		0	$0.0	
	FARM	14	$2.0		14	$2.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**14**	**$2.0**	**20**	**14**	**$2.0**	**20**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 13A	COMM	0	$0.0		18	$1.3	
	FARM	0	$0.0		183	$14.0	
	SEMI-	0	$0.0		12	$3.5	
	RES	0	$0.0		352	$42.2	
	TOTAL	**0**	**$0.0**	**0**	**565**	**$61.0**	**1,400**
SAC 13B	COMM	0	$0.0		4	$4.1	
	FARM	0	$0.0		131	$7.4	
	SEMI-	0	$0.0		1	$0.1	
	RES	0	$0.0		81	$7.5	
	TOTAL	**0**	**$0.0**	**0**	**217**	**$19.1**	**440**
SAC 14	COMM	0	$0.0		25	$4.5	
	FARM	0	$0.0		23	$2.0	
	SEMI-	0	$0.0		6	$1.6	
	RES	0	$0.0		245	$18.6	
	TOTAL	**0**	**$0.0**	**0**	**299**	**$26.7**	**930**
SAC 15	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		11	$0.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**11**	**$0.7**	**10**
SAC 16	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		4	$0.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**4**	**$0.7**	**10**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 17A	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		0	$0.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**0**	**$0.0**	**0**
SAC 17B	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		5	$0.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**5**	**$0.7**	**10**
SAC 18	COMM	0	$0.0		2	$3.9	
	FARM	8	$0.3		20	$0.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		6	$1.4	
	TOTAL	**8**	**$0.3**	**10**	**28**	**$6.0**	**50**
SAC 19	COMM	0	$0.0		0	$0.0	
	FARM	25	$8.6		25	$8.6	
	SEMI-	0	$0.0		0	$0.0	
	RES	2	$0.5		2	$0.5	
	TOTAL	**27**	**$9.1**	**40**	**27**	**$9.1**	**40**
SAC 20	COMM	0	$0.0		0	$0.0	
	FARM	44	$4.0		44	$4.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	15	$1.8		15	$1.8	
	TOTAL	**59**	**$5.8**	**110**	**59**	**$5.8**	**110**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 21A	COMM	0	$0.0		670	$1,085.0	
	FARM	0	$0.0		27	$3.5	
	SEMI-	0	$0.0		32	$17.5	
	RES	0	$0.0		7,347	$682.7	
	TOTAL	**0**	**$0.0**	**0**	**8,076**	**$1,788.7**	**27,000**
SAC 21B	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		16	$3.1	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		2	$0.3	
	TOTAL	**0**	**$0.0**	**0**	**18**	**$3.4**	**50**
SAC 21C	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		57	$6.3	
	SEMI-	0	$0.0		1	$0.1	
	RES	0	$0.0		26	$2.9	
	TOTAL	**0**	**$0.0**	**0**	**84**	**$9.3**	**170**
SAC 21D	COMM	0	$0.0		13	$2.0	
	FARM	12	$0.9		121	$15.2	
	SEMI-	0	$0.0		2	$0.4	
	RES	0	$0.0		176	$23.3	
	TOTAL	**12**	**$0.9**	**20**	**312**	**$40.9**	**810**
SAC 22	COMM	0	$0.0		281	$1,020.4	
	FARM	0	$0.0		97	$11.6	
	SEMI-	0	$0.0		21	$13.9	
	RES	0	$0.0		8,843	$1,288.5	
	TOTAL	**0**	**$0.0**	**0**	**9,242**	**$2,334.4**	**29,400**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 23	COMM	1,219	$1,860.2		1,313	$1,931.5	
	FARM	0	$0.0		0	$0.0	
	SEMI-	81	$50.2		92	$56.1	
	RES	16,045	$2,298.0		17,591	$2,492.0	
	TOTAL	**17,345**	**$4,208.4**	**53,110**	**18,996**	**$4,479.6**	**58,230**
SAC 24	COMM	14	$18.1		52	$60.7	
	FARM	0	$0.0		0	$0.0	
	SEMI-	2	$0.3		8	$9.1	
	RES	1,374	$178.9		3,376	$449.7	
	TOTAL	**1,390**	**$197.3**	**4,550**	**3,436**	**$519.5**	**10,880**
SAC 25	COMM	3,626	$5,219.9		4,010	$5,738.8	
	FARM	0	$0.0		0	$0.0	
	SEMI-	321	$249.4		346	$261.2	
	RES	71,732	$8,265.5		79,422	$9,045.5	
	TOTAL	**75,679**	**$13,734.8**	**237,430**	**83,778**	**$15,045.5**	**262,880**
SAC 26	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		44	$7.3	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		27	$3.2	
	TOTAL	**0**	**$0.0**	**0**	**71**	**$10.5**	**160**
SAC 27	COMM	0	$0.0		20	$1.6	
	FARM	0	$0.0		46	$12.2	
	SEMI-	0	$0.0		1	$0.1	
	RES	0	$0.0		121	$12.4	
	TOTAL	**0**	**$0.0**	**0**	**188**	**$26.3**	**460**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 28	COMM	11	$2.4		11	$2.4	
	FARM	123	$18.7		123	$18.7	
	SEMI-	2	$0.4		2	$0.4	
	RES	169	$16.3		169	$16.3	
	TOTAL	**305**	**$37.8**	**710**	**305**	**$37.8**	**710**
SAC 29A	COMM	0	$0.0		0	$0.0	
	FARM	8	$2.0		8	$2.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**8**	**$2.0**	**20**	**8**	**$2.0**	**20**
SAC 29B	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		4	$0.3	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**4**	**$0.3**	**10**
SAC 30	COMM	0	$0.0		0	$0.0	
	FARM	1	$0.2		1	$0.2	
	SEMI-	0	$0.0		0	$0.0	
	RES	10	$1.7		10	$1.7	
	TOTAL	**11**	**$1.9**	**40**	**11**	**$1.9**	**40**
SAC 31	COMM	0	$0.0		3	$0.3	
	FARM	0	$0.0		31	$5.9	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		5	$0.4	
	TOTAL	**0**	**$0.0**	**0**	**39**	**$6.6**	**60**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 32	COMM	0	$0.0		1	$0.1	
	FARM	0	$0.0		0	$0.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		10	$1.3	
	TOTAL	**0**	**$0.0**	**0**	**11**	**$1.4**	**30**
SAC 33	COMM	0	$0.0		9	$2.3	
	FARM	0	$0.0		154	$26.0	
	SEMI-	0	$0.0		2	$0.6	
	RES	0	$0.0		247	$33.1	
	TOTAL	**0**	**$0.0**	**0**	**412**	**$62.0**	**1,010**
SAC 34	COMM	8	$3.1		8	$3.1	
	FARM	68	$8.7		68	$8.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	12	$1.7		12	$1.7	
	TOTAL	**88**	**$13.5**	**120**	**88**	**$13.5**	**120**
SAC 35	COMM	109	$36.8		109	$36.8	
	FARM	25	$2.5		25	$2.5	
	SEMI-	8	$0.8		8	$0.8	
	RES	333	$24.9		333	$24.9	
	TOTAL	**475**	**$65.0**	**1,130**	**475**	**$65.0**	**1,130**
SAC 36	COMM	0	$0.0		4	$0.5	
	FARM	0	$0.0		0	$0.0	
	SEMI-	2	$0.2		2	$0.2	
	RES	1	$0.7		6	$1.0	
	TOTAL	**3**	**$0.9**	**0**	**12**	**$1.7**	**20**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SAC 37	COMM	0	$0.0		32	$5.1	
	FARM	0	$0.0		5	$0.2	
	SEMI-	0	$0.0		2	$0.2	
	RES	0	$0.0		77	$4.6	
	TOTAL	**0**	**$0.0**	**0**	**116**	**$10.1**	**260**
SAC 38	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		0	$0.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	10	$0.6		10	$0.6	
	TOTAL	**10**	**$0.6**	**30**	**10**	**$0.6**	**30**
SAC 39	COMM	16	$2.7		16	$2.7	
	FARM	78	$13.4		78	$13.4	
	SEMI-	3	$0.9		3	$0.9	
	RES	178	$14.0		178	$14.0	
	TOTAL	**275**	**$31.0**	**750**	**275**	**$31.0**	**750**
SAC 40	COMM	1	$0.1		1	$0.1	
	FARM	3	$0.1		3	$0.1	
	SEMI-	0	$0.0		0	$0.0	
	RES	2	$0.4		2	$0.4	
	TOTAL	**6**	**$0.6**	**10**	**6**	**$0.6**	**10**
SAC 41	COMM	3	$0.6		3	$0.6	
	FARM	9	$0.7		9	$0.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	31	$3.2		31	$3.2	
	TOTAL	**43**	**$4.5**	**110**	**43**	**$4.5**	**110**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 1	COMM	3	$1.4		9	$2.3	
	FARM	31	$3.2		51	$9.3	
	SEMI-	0	$0.0		2	$0.1	
	RES	10	$3.5		32	$9.2	
	TOTAL	**44**	**$8.1**	**80**	**94**	**$20.9**	**190**
SJ 2	COMM	0	$0.0		0	$0.0	
	FARM	41	$8.7		41	$8.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**41**	**$8.7**	**60**	**41**	**$8.7**	**60**
SJ 3	COMM	0	$0.0		1	$42.8	
	FARM	5	$1.8		160	$22.3	
	SEMI-	0	$0.0		3	$0.5	
	RES	0	$0.0		39	$4.4	
	TOTAL	**5**	**$1.8**	**10**	**203**	**$70.0**	**370**
SJ 4	COMM	2	$17.4		2	$17.4	
	FARM	34	$5.8		34	$5.8	
	SEMI-	0	$0.0		0	$0.0	
	RES	1	$0.1		1	$0.1	
	TOTAL	**37**	**$23.3**	**50**	**37**	**$23.3**	**50**
SJ 5	COMM	2	$26.0		3	$145.5	
	FARM	21	$4.2		45	$5.8	
	SEMI-	2	$0.0		2	$0.0	
	RES	28	$2.3		48	$3.6	
	TOTAL	**53**	**$32.5**	**130**	**98**	**$154.9**	**240**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 6A	COMM	1	$0.1		1	$0.1	
	FARM	180	$20.2		180	$20.2	
	SEMI-	1	$0.2		1	$0.2	
	RES	104	$7.5		104	$7.5	
	TOTAL	**286**	**$28.0**	**590**	**286**	**$28.0**	**590**
SJ 6B	COMM	5	$4.9		5	$4.9	
	FARM	133	$8.9		133	$8.9	
	SEMI-	0	$0.0		0	$0.0	
	RES	5	$0.7		5	$0.7	
	TOTAL	**143**	**$14.5**	**220**	**143**	**$14.5**	**220**
SJ 7	COMM	1	$0.1		1	$0.1	
	FARM	113	$11.8		113	$11.8	
	SEMI-	0	$0.0		0	$0.0	
	RES	4	$0.3		4	$0.3	
	TOTAL	**118**	**$12.2**	**170**	**118**	**$12.2**	**170**
SJ 8	COMM	16	$12.0		16	$12.0	
	FARM	357	$45.1		357	$45.1	
	SEMI-	0	$0.0		0	$0.0	
	RES	26	$2.1		26	$2.1	
	TOTAL	**399**	**$59.2**	**590**	**399**	**$59.2**	**590**
SJ 9	COMM	1	$0.3		1	$0.3	
	FARM	195	$14.9		195	$14.9	
	SEMI-	0	$0.0		0	$0.0	
	RES	15	$1.7		15	$1.7	
	TOTAL	**211**	**$16.9**	**330**	**211**	**$16.9**	**330**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 10	COMM	1	$0.4		1	$0.4	
	FARM	59	$7.2		99	$12.8	
	SEMI-	0	$0.0		0	$0.0	
	RES	1	$0.3		3	$0.4	
	TOTAL	**61**	**$7.9**	**70**	**103**	**$13.6**	**160**
SJ 11	COMM	0	$0.0		0	$0.0	
	FARM	58	$2.2		58	$2.2	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**58**	**$2.2**	**90**	**58**	**$2.2**	**90**
SJ 12	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		15	$1.6	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**15**	**$1.6**	**20**
SJ 13	COMM	0	$0.0		0	$0.0	
	FARM	9	$0.5		12	$0.6	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**9**	**$0.5**	**10**	**12**	**$0.6**	**10**
SJ 14	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		0	$0.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**0**	**$0.0**	**0**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 15	COMM	2	$1.4		2	$1.4	
	FARM	189	$26.6		189	$26.6	
	SEMI-	0	$0.0		0	$0.0	
	RES	16	$1.2		16	$1.2	
	TOTAL	**207**	**$29.2**	**350**	**207**	**$29.2**	**350**
SJ 16	COMM	15	$50.9		15	$50.9	
	FARM	499	$115.6		499	$115.6	
	SEMI-	1	$0.1		1	$0.1	
	RES	180	$11.7		180	$11.7	
	TOTAL	**695**	**$178.3**	**1,410**	**695**	**$178.3**	**1,410**
SJ 17	COMM	923	$539.3		930	$552.7	
	FARM	196	$17.2		200	$17.5	
	SEMI-	60	$17.7		62	$21.2	
	RES	8,599	$784.0		9,378	$921.9	
	TOTAL	**9,778**	**$1,358.2**	**31,260**	**10,570**	**$1,513.3**	**34,070**
SJ 18	COMM	0	$0.0		0	$0.0	
	FARM	124	$21.9		124	$21.9	
	SEMI-	0	$0.0		0	$0.0	
	RES	5	$0.3		5	$0.3	
	TOTAL	**129**	**$22.2**	**210**	**129**	**$22.2**	**210**
SJ 19	COMM	0	$0.0		1	$0.1	
	FARM	0	$0.0		47	$11.7	
	SEMI-	0	$0.0		1	$0.2	
	RES	0	$0.0		2	$0.1	
	TOTAL	**0**	**$0.0**	**0**	**51**	**$12.1**	**80**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 20	COMM	0	$0.0		1	$0.1	
	FARM	7	$0.5		13	$1.5	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		2	$0.3	
	TOTAL	**7**	**$0.5**	**10**	**16**	**$1.9**	**30**
SJ 21	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		3	$2.4	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**0**	**$0.0**	**0**	**3**	**$2.4**	**0**
SJ 22	COMM	12	$27.6		95	$423.8	
	FARM	28	$7.6		220	$49.1	
	SEMI-	1	$8.1		5	$11.2	
	RES	204	$14.2		1,771	$131.9	
	TOTAL	**245**	**$57.5**	**720**	**2,091**	**$616.0**	**5,850**
SJ 23	COMM	0	$0.0		0	$0.0	
	FARM	35	$6.7		35	$6.7	
	SEMI-	0	$0.0		0	$0.0	
	RES	5	$0.6		5	$0.6	
	TOTAL	**40**	**$7.3**	**70**	**40**	**$7.3**	**70**
SJ 24	COMM	0	$0.0		0	$0.0	
	FARM	1	$0.3		1	$0.3	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		0	$0.0	
	TOTAL	**1**	**$0.3**	**0**	**1**	**$0.3**	**0**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 25	COMM	3	$87.4		3	$87.4	
	FARM	10	$2.6		10	$2.6	
	SEMI-	4	$11.7		4	$11.7	
	RES	15	$5.3		15	$5.3	
	TOTAL	**32**	**$107.0**	**60**	**32**	**$107.0**	**60**
SJ 26	COMM	1	$0.4		1	$0.4	
	FARM	150	$36.7		203	$48.3	
	SEMI-	4	$1.9		5	$2.6	
	RES	131	$19.8		163	$24.6	
	TOTAL	**286**	**$58.8**	**690**	**372**	**$75.9**	**880**
SJ 27	COMM	0	$0.0		0	$0.0	
	FARM	14	$7.4		14	$7.4	
	SEMI-	1	$0.8		1	$0.8	
	RES	4	$0.4		4	$0.4	
	TOTAL	**19**	**$8.6**	**30**	**19**	**$8.6**	**30**
SJ 28	COMM	6	$14.2		6	$14.2	
	FARM	114	$11.4		114	$11.4	
	SEMI-	1	$0.2		1	$0.2	
	RES	67	$9.5		67	$9.5	
	TOTAL	**188**	**$35.3**	**400**	**188**	**$35.3**	**400**
SJ 29	COMM	3	$0.5		3	$0.5	
	FARM	39	$4.4		39	$4.4	
	SEMI-	1	$0.0		1	$0.0	
	RES	5	$1.4		5	$1.4	
	TOTAL	**48**	**$6.3**	**70**	**48**	**$6.3**	**70**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 30A	COMM	0	$0.0		70	$439.6	
	FARM	0	$0.0		140	$14.0	
	SEMI-	0	$0.0		14	$2.5	
	RES	0	$0.0		4,178	$489.7	
	TOTAL	**0**	**$0.0**	**0**	**4,402**	**$945.8**	**15,160**
SJ 30B	COMM	0	$0.0		27	$86.2	
	FARM	0	$0.0		18	$2.9	
	SEMI-	0	$0.0		2	$7.1	
	RES	0	$0.0		44	$4.0	
	TOTAL	**0**	**$0.0**	**0**	**91**	**$100.2**	**180**
SJ 30C	COMM	0	$0.0		34	$51.9	
	FARM	0	$0.0		36	$3.3	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		772	$110.2	
	TOTAL	**0**	**$0.0**	**0**	**842**	**$165.4**	**2,820**
SJ 31	COMM	11	$5.7		11	$5.7	
	FARM	211	$22.5		211	$22.5	
	SEMI-	2	$0.1		2	$0.1	
	RES	63	$7.4		63	$7.4	
	TOTAL	**287**	**$35.7**	**530**	**287**	**$35.7**	**530**
SJ 32	COMM	0	$0.0		433	$376.5	
	FARM	0	$0.0		0	$0.0	
	SEMI-	0	$0.0		47	$12.0	
	RES	0	$0.0		5,820	$416.2	
	TOTAL	**0**	**$0.0**	**0**	**6,300**	**$804.7**	**20,840**

TABLE 6-6 (Continued)
PROPERTY (In $ Millions) AND POPULATION AT RISK

Economic Assess. Area	Land Use Code	100-Year FEMA Zone			Total Area (Includes 100-Year and Outside 100-Year)		
		Number of Parcels	Value of Structure & Content	Population at Risk	Number of Parcels	Value of Structure & Content	Population at Risk
SJ 33	COMM	0	$0.0		0	$0.0	
	FARM	0	$0.0		13	$2.0	
	SEMI-	0	$0.0		0	$0.0	
	RES	0	$0.0		5	$0.6	
	TOTAL	**0**	**$0.0**	**0**	**18**	**$2.6**	**40**
SJ 34	COMM	1	$2.4		1	$2.4	
	FARM	33	$5.8		33	$5.8	
	SEMI-	3	$0.1		3	$0.1	
	RES	32	$5.4		32	$5.4	
	TOTAL	**69**	**$13.7**	**160**	**69**	**$13.7**	**160**
SJ 35	COMM	5	$4.5		5	$4.5	
	FARM	77	$13.7		77	$13.7	
	SEMI-	1	$0.2		1	$0.2	
	RES	20	$3.2		20	$3.2	
	TOTAL	**103**	**$21.6**	**180**	**103**	**$21.6**	**180**
SAC BASIN TOTALS	COMM	5,775	$7,440.6		9,118	$11,463.1	
	FARM	1,477	$216.3		3,795	$472.2	
	SEMI-	513	$338.6		868	$539.9	
	RES	95,464	$11,324.9		146,303	$16,875.9	
	TOTAL	**103,229**	**$19,320.4**	**314,940**	**160,084**	**$29,351.1**	**486,160**
SAN JOAQUIN BASIN TOTALS	COMM	1,014	$796.9		1,678	$2,324.1	
	FARM	2,963	$435.4		3,732	$561.6	
	SEMI-	82	$41.1		158	$70.8	
	RES	9,540	$882.9		22,824	$2,175.9	
	TOTAL	**13,599**	**$2,156.3**	**38,550**	**28,392**	**$5,132.4**	**86,510**

TABLE 6-7
CENTRAL VALLEY CROP VALUES

CROP TYPE	RANGE OF CROP VALUES dollars per acre
CORN	$ 450 to $ 750
RICE	700 to 1,100
ALMONDS / WALNUTS	1,800 to 4,200
COTTON	800 to 1,400
TOMATO (Processed & Fresh)	1,700 to 6,000
GRAPES (Processed, Table & Wine)	3,000 to 6,500
PASTURE (Non-Irrigated & Irrigated)	10 to 150
FIELD CROPS	300 to 1,200
TRUCK CROPS	1,200 to 7,500
FRUIT and NUT CROPS	2,300 to 6,500

TABLE 6-8
LAND USE AND ACREAGE OF AGRICULTURAL AREAS AT RISK

Economic Assess. Area	Major Crop Land Uses							Misc. Crop Land Uses			Non-Crop			Total Acres
	Corn	Rice	Almonds-Walnuts	Cotton	Tomato	Grapes	Pasture	Field Crops[a]	Truck Crops[b]	Fruit & Nut[c]	Native Veg.	Idle Land	Urban Area	
SAC 1	150	40	7,990	0	0	0	4,580	2,900	350	2,090	18,380	1,200	6,440	44,120
SAC 2	730	390	24,050	0	0	0	2,120	8,060	0	6,660	14,370	250	620	57,250
SAC 3	350	0	940	0	140	0	420	2,100	180	460	190	250	70	5,100
SAC 4A	340	12,200	1,560	0	0	0	380	1,620	10	50	400	0	200	16,760
SAC 4B	220	13,220	420	0	690	0	300	1,150	560	600	780	170	340	18,450
SAC 4C	390	8,370	980	0	1,370	0	550	4,510	780	1,240	1,620	870	760	21,440
SAC 5A	90	180	150	0	300	0	10	610	80	180	940	90	1,150	3,780
SAC 5B	1,910	11,880	600	0	3,820	0	2,550	16,690	3,510	620	2,730	2,620	640	47,570
SAC 5C	1,150	22,270	440	0	4,200	0	1,250	14,800	1,390	40	850	990	110	47,490
SAC 5D	190	2,770	60	0	1,320	0	0	2,870	360	370	520	120	50	8,630
SAC 6	340	8,900	3,020	0	4,470	0	150	13,290	1,930	240	690	230	390	33,650
SAC 7	0	1,180	0	0	0	0	90	2,090	0	20	270	100	60	3,810
SAC 8A	100	16,320	3,700	0	1,160	0	680	2,530	2,760	16,660	1,500	800	1,020	47,230
SAC 8B	0	440	1,550	0	0	0	120	350	210	4,600	260	500	4,790	12,820
SAC 9	4,620	15,630	1,110	0	15,040	0	380	18,980	5,850	440	2,700	320	560	65,630
SAC 10A	0	0	0	0	0	0	0	0	0	0	90	0	1,420	1,510
SAC 10B	0	420	700	0	0	0	170	130	0	8,580	370	150	820	11,340

TABLE 6-8 (Continued)
LAND USE AND ACREAGE OF AGRICULTURAL AREAS AT RISK

Economic Assess. Area	Major Crop Land Uses							Misc. Crop Land Uses			Non-Crop			Total Acres
	Corn	Rice	Almonds-Walnuts	Cotton	Tomato	Grapes	Pasture	Field Crops[a]	Truck Crops[b]	Fruit & Nut[c]	Native Veg.	Idle Land	Urban Area	
SAC 11A	40	1,860	150	0	0	0	200	220	100	710	1,570	410	4,660	9,920
SAC 11B	0	1,320	1,250	0	0	0	720	140	220	4,930	2,760	860	700	12,900
SAC 12	0	0	2,010	0	0	0	370	160	20	230	410	20	100	3,320
SAC 13A	60	9,680	1,280	0	0	0	940	1,360	0	1,010	1,810	450	660	17,250
SAC 13B	1,120	7,180	1,510	0	270	0	3,640	5,860	60	870	830	140	520	22,000
SAC 14	80	0	150	0	1,460	0	340	1,120	170	0	370	40	160	3,890
SAC 15	40	290	0	0	350	0	300	730	220	0	110	0	10	2,050
SAC 16	60	50	170	0	1,390	0	130	890	340	0	170	0	10	3,210
SAC 17A	0	1,130	0	0	0	0	0	1,240	0	0	140	250	700	3,460
SAC 17B	1,070	2,530	0	0	0	0	290	1,920	0	0	220	680	280	6,990
SAC 18	1,170	0	0	0	740	0	720	3,720	10	0	140	40	170	6,710
SAC 19	0	0	2,970	0	230	0	0	2,550	0	100	150	190	10	6,200
SAC 20	370	0	330	0	1,300	0	150	3,040	140	60	450	90	140	6,070
SAC 21A	270	0	10	0	0	30	610	2,820	210	70	1,000	1,640	6,430	13,090
SAC 21B	300	0	0	0	300	200	600	1,190	0	40	360	0	40	3,030
SAC 21C	460	0	0	0	740	230	600	3,310	130	50	140	150	60	5,870
SAC 21D	2,050	0	40	0	4,280	210	2,990	12,190	420	0	750	160	410	23,500
SAC 22	910	22,910	10	0	620	0	1,060	14,650	270	180	3,820	1,520	7,620	53,570
SAC 23	0	0	0	0	0	0	0	0	0	0	150	0	6,390	6,540
SAC 24	0	0	0	0	0	0	0	0	0	0	40	20	820	880

TABLE 6-8 (Continued)
LAND USE AND ACREAGE OF AGRICULTURAL AREAS AT RISK

Economic Assess. Area	Major Crop Land Uses							Misc. Crop Land Uses			Non-Crop			Total Acres
	Corn	Rice	Almonds-Walnuts	Cotton	Tomato	Grapes	Pasture	Field Crops[a]	Truck Crops[b]	Fruit & Nut[c]	Native Veg.	Idle Land	Urban Area	
SAC 25	250	0	0	0	0	0	230	1,030	100	10	2,930	140	35,770	40,460
SAC 26	350	0	0	0	630	1,050	370	1,660	40	340	230	10	60	4,740
SAC 27	1,610	0	0	0	1,210	1,120	210	2,720	0	1,870	200	30	260	9,230
SAC 28	2,280	0	0	0	1,760	1,580	5,720	4,750	50	590	8,460	1,260	1,330	27,780
SAC 29A	890	0	0	0	0	0	2,840	1,440	0	0	1,330	10	40	6,550
SAC 29B	0	0	0	0	0	0	1,230	90	0	0	60	10	0	1,390
SAC 30	2,410	0	0	0	660	0	1,830	2,070	0	0	2,490	40	40	9,540
SAC 31	2,180	0	10	0	2,120	620	870	5,200	0	450	230	60	80	11,820
SAC 32	230	0	0	0	170	140	110	530	0	1,230	120	10	30	2,570
SAC 33	5,320	0	0	0	1,150	20	1,200	6,130	0	1,910	480	70	350	16,630
SAC 34	680	0	0	0	0	20	290	760	0	470	50	0	50	2,320
SAC 35	7,260	0	0	0	0	130	50	3,560	0	280	1,010	20	540	12,850
SAC 36	0	0	0	0	0	0	0	0	0	90	650	40	30	810
SAC 37	110	0	0	0	0	0	50	110	0	0	20	40	140	470
SAC 38	5,230	0	0	0	310	0	150	2,450	10	260	280	40	90	8,820
SAC 39	2,470	0	0	0	1,500	1,500	90	1,580	400	160	320	80	490	8,590
SAC 40	1,250	0	0	0	210	0	210	580	0	20	350	920	20	3,560
SAC 41	620	0	0	0	0	0	530	4,160	410	0	400	2,610	80	8,810
TOTAL - SAC	51,720	161,160	57,160	0	53,910	6,850	43,390	188,610	21,290	58,780	81,660	20,710	88,730	833,970

TABLE 6-8 (Continued)
LAND USE AND ACREAGE OF AGRICULTURAL AREAS AT RISK

Economic Assess. Area	Major Crop Land Uses							Misc. Crop Land Uses			Non-Crop			Total Acres
	Corn	Rice	Almonds-Walnuts	Cotton	Tomato	Grapes	Pasture	Field Crops[a]	Truck Crops[b]	Fruit & Nut[c]	Native Veg.	Idle Land	Urban Area	
SJ 1	40	0	580	100	0	0	680	140	90	60	7,010	60	1,410	10,170
SJ 2	1,140	0	450	990	0	600	3,300	1,860	530	0	2,860	1,700	170	13,600
SJ 3	200	0	40	460	0	780	1,240	0	0	0	2,450	20	40	5,230
SJ 4	10	0	280	3,410	220	380	1,500	1,760	220	100	2,440	110	300	10,730
SJ 5	20	0	90	2,320	40	650	1,770	1,690	340	0	14,380	270	580	22,150
SJ 6A	600	430	610	12,710	620	890	10,130	7,260	1,040	1,070	16,300	290	710	52,660
SJ 6B	1,230	0	40	9,900	1,010	230	11,580	2,890	410	100	6,300	1,340	480	35,510
SJ 7	800	0	1,610	2,160	0	80	1,820	820	0	280	4,090	0	250	11,910
SJ 8	1,870	0	4,890	2,490	0	6,190	1,640	1,210	30	1,480	1,960	1,470	970	24,200
SJ 9	1,100	0	2,170	2,850	0	270	1,530	780	0	20	240	210	360	9,530
SJ 10	750	0	220	2,810	0	220	4,230	2,950	0	80	1,720	720	330	14,030
SJ 11	40	0	0	3,900	1,260	0	2,840	930	230	0	1,360	100	120	10,780
SJ 12	0	0	0	5,960	5,020	0	1,550	1,990	560	0	750	0	80	15,910
SJ 13	0	0	0	0	0	0	1,850	0	0	0	6,610	260	0	8,720
SJ 14	0	0	0	0	0	0	1,780	0	0	0	1,400	0	0	3,180
SJ 15	1,150	0	0	0	0	420	2,440	890	180	0	5,430	540	150	11,200
SJ 17	910	610	2,300	220	910	0	1,740	730	130	880	910	400	6,180	15,920

TABLE 6-8 (Continued)
LAND USE AND ACREAGE OF AGRICULTURAL AREAS AT RISK

Economic Assess. Area	Major Crop Land Uses							Misc. Crop Land Uses			Non-Crop			Total Acres
	Corn	Rice	Almonds-Walnuts	Cotton	Tomato	Grapes	Pasture	Field Crops[a]	Truck Crops[b]	Fruit & Nut[c]	Native Veg.	Idle Land	Urban Area	
SJ 18	2,360	0	590	0	0	680	2,650	390	100	880	3,500	180	530	11,860
SJ 19	1,680	0	0	0	0	0	3,380	80	0	0	1,910	50	130	7,230
SJ 20	20	0	20	0	100	0	490	600	0	0	190	0	20	1,440
SJ 21	380	0	0	0	0	0	100	350	0	0	130	0	20	980
SJ 22	3,450	0	5,000	0	120	880	1,160	500	90	570	2,230	60	2,170	16,230
SJ 23	520	0	0	0	0	0	4,470	50	70	0	1,420	0	20	6,550
SJ 24	200	0	20	0	200	0	0	120	10	0	100	20	0	670
SJ 25	390	0	960	0	0	80	200	120	0	50	2,450	70	210	4,530
SJ 26	1,500	0	1,090	0	730	720	4,220	3,960	820	40	660	60	740	14,540
SJ 27	370	0	0	0	260	0	370	440	0	0	210	0	230	1,880
SJ 28	610	0	40	0	1,730	0	3,850	3,130	530	0	550	10	920	11,370
SJ 29	850	0	130	0	720	0	1,700	890	440	0	160	0	170	5,060
SJ 30A	880	0	210	0	110	0	2,680	2,990	2,450	150	1,670	50	4,840	16,030
SJ 30B	160	0	300	0	0	10	80	180	60	0	190	30	500	1,510
SJ 30C	570	0	200	0	90	90	1,350	460	300	0	220	30	990	4,300
SJ 31	3,180	0	190	0	2,690	1,090	7,930	9,970	4,750	70	850	130	1,260	32,110
SJ 32	0	0	0	0	0	0	0	110	0	0	80	0	3,830	4,020

TABLE 6-8 (Continued)
LAND USE AND ACREAGE OF AGRICULTURAL AREAS AT RISK

Economic Assess. Area	Major Crop Land Uses							Misc. Crop Land Uses			Non-Crop			Total Acres
	Corn	Rice	Almonds-Walnuts	Cotton	Tomato	Grapes	Pasture	Field Crops[a]	Truck Crops[b]	Fruit & Nut[c]	Native Veg.	Idle Land	Urban Area	
SJ 33	240	0	60	0	90	150	210	400	250	0	80	30	20	1,530
SJ 34	770	0	20	0	210	0	1,990	1,840	200	0	340	0	840	6,210
SJ 35	240	0	40	0	1,150	0	1,260	890	2,700	0	90	40	80	6,490
TOTAL-SJ	28,230	1,040	22,150	50,280	17,280	14,410	89,710	53,370	16,530	5,830	93,240	8,250	29,650	429,970
TOTAL-STUDY	79,950	162,200	79,310	50,280	71,190	21,260	133,100	241,980	37,820	64,610	174,900	28,960	118,380	1,263,940

Notes:
a) Field Crops : include - barley, beans, flax, grain & hay, oats, safflower, sorghum, sudan, sugar beets, sunflowers, wheat.
b) Truck Crops : include - asparagus, cabbage, carrots, celery, cucumbers, garlic, green beans, lettuce, melons, onions, peppers, potatoes, squash, strawberries, sweet potatoes.
c) Fruit & Nut: includes - apples, apricots, cherries, eucalyptus, figs, grapefruit, kiwis, nectarines, olives, oranges, peaches, pears, pistachios, plums, prunes.